Introduction

Chapter Background

Science and engineering (S&E), and the technological developments that emerge from S&E activities, enable high-wage nations like the United States to compete alongside low-wage countries in today's increasingly global marketplace. Nearly a universally accepted wisdom today, the importance of S&E activities to the Nation's economic well-being was emphasized 50 years ago in *Science and Public Policy*, a report prepared for then-President Harry S Truman under the guidance of John Steelman (1947). (See chapter 1.) It stated, "Only through research and more research can we provide the basis for an expanding economy, and continued high employment levels." In the years following World War II, U.S. industry became an integral part of the research enterprise. Not just as a performer of R&D, U.S. industry became the main conduit for diffusing and commercializing investments in S&T made by industry, academia, and government. The *Science and Engineering Indicators 2000* continues to acknowledge the important role played by industry. Contained within this chapter are indicators or proxies that identify trends and provide measurements of industry's part in the S&T enterprise and, whenever possible, place U.S. activity and standing in the more science-based industries in a global context.

The highly competitive global marketplace facing the Nation today is yet another condition predicted 50 years ago in the Steelman report. Steelman (1947) warned of the reemergence of war-torn economies in Europe and Asia and the emergence of a new cadre of nation traders that would "...confront us with competition from other national economies of a sort we have not hitherto had to meet." If a nation's competitiveness is judged by its ability to produce goods that find demand in the international marketplace while simultaneously maintaining—if not improving—the standard of living of its citizens (OECD 1996), then the United States appears to have met the challenges outlined in the Steelman report. Now some 50 years after that report was written, the U.S. economy ranks as the world's largest, and Americans enjoy one of the world's higher standards of living—although many other parts of the world are closing the gap. (See figure 7-1 and appendix tables 7-1, 7-2, and 7-3.)

Chapter Organization

This chapter begins with a review of the market competitiveness of industries that rely heavily on R&D; these are often referred to as high-technology industries.[1] The importance of high-technology industries is linked to their high R&D spending and performance, which produce innovations that spill over into other economic sectors. Additionally, these industries help train new scientists, engineers, and other technical personnel. (See Nadiri 1993 and Tyson 1992.) The market competitiveness of a nation's technological advances, as embodied in new products and processes associated with these industries, can also serve as an indicator of the effectiveness of that country's S&T enterprise. The marketplace provides a relevant economic evaluation of a country's use of S&T.

U.S. high-technology industry competitiveness is assessed through an examination of market share trends worldwide, at home, and in various regions of the world. New data on royalties and fees generated from U.S. imports and exports of technological know-how are used to gauge U.S. competitiveness when technological know-how is sold or rented as intangible (intellectual) property.

The chapter explores several leading indicators of technology development (1) via an examination of changing emphases in industrial R&D among the major industrial countries and (2) through an extensive analysis of patenting trends. New information on international patenting trends of U.S. foreign inventors in several important technologies is presented.

The chapter concludes with a presentation of information on trends in venture capital disbursements. Venture capital is an important source of funds used in the formation and expansion of small high-technology companies. This section examines venture capital disbursements by stage of financing and by technology area in the United States.

U.S. Technology in the Marketplace

Most countries in the world acknowledge a symbiotic relationship between national investments in S&T and competitiveness in the marketplace: S&T support business competitiveness in international trade, and commercial success in the global marketplace provides the resources needed to support new S&T. Consequently, the health of the nation's economy becomes a performance measure for the national investment in R&D and in S&E.

This section discusses U.S. "competitiveness," broadly defined here as the ability of U.S. firms to sell products in the international marketplace. A great deal of attention is given to science-based industries producing products that embody above-average levels of R&D in their development (hereafter referred to as *high-technology industries*). OECD currently identifies four industries as high-technology based on their high R&D intensities: aerospace, computers and office machinery, electronics-communications, and pharmaceuticals.[2]

[1] In this chapter, high-technology industries are identified using R&D intensities calculated by the OECD. There is no single preferred methodology for identifying high-technology industries. The identification of those industries considered to be high-technology has generally relied on a calculation comparing R&D intensities. R&D intensity, in turn, has typically been determined by comparing industry R&D expenditures and/or numbers of technical people employed (such as scientists, engineers, and technicians) to industry value added or the total value of its shipments.

[2] In designating these high-technology industries, the OECD took into account both direct and indirect R&D intensities for 10 countries: the United States, Japan, Germany, France, the United Kingdom, Canada, Italy, the Netherlands, Denmark and Australia. Direct intensities were calculated by the ratio of R&D expenditure to output (production) in 22 industrial sectors. Each sector was given a weight according to its share in the total output of the 10 countries using purchasing power parities as exchange rates. Indirect intensity calculations were made using technical coefficients of industries